XSPACE USER'S MANUAL

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1. Introduction

Xspace is a graphical version of space running under the X window system. This version is used to show the resistance mesh and the boundary-element mesh that are generated by the program, and to show how the program works from an algorithmic point of view.

Xspace can be invoked as follows:

Xspace [space/space3d options] [-X] [X toolkit options] [cell]

All options of *space* or *space3d* (see the Space User's Manual). may be used with Xspace. When an option of *Xspace* is set on the command line that corresponds to an option that can be set in the menu of *Xspace*, this option will be enabled in the menu. Also when a cell is given as an argument, that cell will be enabled in the database menu.

The option **-X** is used to omit the menu bar of *Xspace.* In that case, a cell name must be given as argument and all extraction options have to be set on the command line and/or in the parameter file. In contrast to when the option **-X** is not used, the program will immediately start the extraction.

Further, the following standard X window toolkit options are recognized by *Xspace:*

-bg *color* or
-background *color* — Set the background color to *color*. Available color names are normally found in the file '/usr/lib/X11/rgb.txt'.

-bd *color* or
-bordercolor *color* — Set the window border color to *color*.

-bw *width* or
-borderwidth *width* — Set the window border width to *width*.

-display *host*:*display*[.*screen*] — Specifies the X server the program should connect to (e.g. victor:0), this is the display that the program will use for graphical output and input. If omitted the value of the environment variable DISPLAY is used. If this environment variable is not set properly either, an error will be reported by the X window system.

-fg *color* or
-foreground *color* — Set the foreground color to *color*.

-fn *font* or
-font *font* — The specified font will be used instead of the default font (which is 'variable', or as specified in ~/.Xdefaults).

-geometry *WxH+X+Y*	Set the window size to *W* by *H* and place the window at location *X*,*Y*.
-name *name*	Set the application name to *name* which is used to retrieve the default setting from the X resource database or the *.Xdefaults* file. This facilitates easy switching from one set of X window related preferences to another.
-rv or **-reverse**	Set 'reverse video' mode. The results are undefined for color screens.
+rv	Unset 'reverse video' mode (can be used to overrule a 'reverse video' statement in the user preferences).
-title *title*	Set the title to *title*. The title is used by some window managers that provide frames with title bars around windows.
-xrm '<any X resource>'	This can be used to overrule any X resource setting from the command line.

2. Menu entries

Unless the option **-X** is used, *Xspace* has the following menus:

2.1 extract menu

extract	Start the extraction process.
display clear	Clear the display.
quit	Stop the program and exit.
pause	Temporarily pause the program.
sync	Toggle X window system synchronous mode, for easier debugging and sometimes better pictures.
run free	Don't look for events any more, gives fastest drawing but can not be interrupted. The extraction must run until the cell is completely finished.
robot	Start/stop a free hand demo by executing the commands that are described in the file 'program'.
reset robot	Reset the automatic demo program.

2.2 database menu

A list of cells in the database. Radio buttons.

2.3 options menu

resistance	Toggle non-metal interconnect resistance extraction. Equivalent to the -r option of space.
metal resistance	Toggle non-metal and metal interconnect resistance extraction. Equivalent to the -R option of space.
mesh refinement	Apply a mesh refinement for resistance extraction. This gives more accurate resistance values.
capacitance	Toggle ground capacitance extraction. Equivalent to the -c option of space.
coupling cap.	Toggle coupling capacitance extraction. Equivalent to the -C option of space.

lat. coup. cap. Toggle lateral coupling capacitance extraction. Equivalent to the -l option of space.

3D capacitance Toggle 3-dimensional capacitance extraction. Equivalent to the -3 option of space.

inter. sub. res. Toggle interpolated substrate resistance extraction. Equivalent to the -b option of space.

3D sub. res. Toggle 3D substrate resistance extraction. Equivalent to the -B option of space.

heuristics off Toggle network reduction heuristics. Equivalent to the -n option of space.

BE mesh only Construct the boundary-element mesh for 3D capacitance extraction or 3D substrate resistance extraction but do not compute the capacitances or resistances (this option is useful to inspect the mesh that is generated).

selective elim. Extract RC models that are accurate up to a certain frequency.

discard ckt Do not update the circuit database, useful under R4 of the Nelsis system.

2.4 display menu

PairBoundary Draw white lines around each tile.

DrawTile Draw tiles when they are found.

DrawEdge Draw input edges.

DrawResistor Toggle resistance drawing. Only useful with resistance extraction enabled.

UndrawResistor Toggle resistance undrawing. Only useful with resistance extraction enabled.

DrawOutResistor Toggle drawing of resistances that are written to database. Only useful with resistance extraction enabled.

DrawFEMesh Toggle finite-element drawing for resistance extraction. Only useful with resistance extraction enabled.

DrawEquiLines Toggle drawing of equi-potential lines in finite-element mesh. Only useful with resistance extraction enabled.

DrawBEMesh Toggle drawing of 3D boundary elements. Only useful with 3D capacitance extraction or 3D substrate resistance extraction enabled.

DrawGreen Toggle drawing of 3D green function evaluations. Only useful with 3D capacitance extraction or 3D substrate resistance extraction enabled.

3 dimensional Toggle 3-dimensional drawing of boundary elements and green function evaluation. Only useful with 3D capacitance extraction or 3D substrate resistance extraction enabled.

DrawSubTerm Toggle drawing of substrate terminals. Only useful with substrate resistance extraction enabled.

DrawDelaunay Toggle drawing of Delaunay diagram between substrate terminals. Only useful with interpolated substrate resistance extraction enabled.

DrawSubResistor

Toggle drawing of substrate resistances between substrate terminals. Only useful with substrate resistance extraction enabled.

2.5 speed scroll bar

Use the left bottom to move the slider, to the left is slower and to the right is faster.

3. The parameter file

Besides that menu entries can be set by setting corresponding commandline options (e.g. the menu entry "coupling cap." can also be set by setting the commandline option **-C**), entries from the menu can also be set by setting corresponding parameters in the parameter file. Setting the following parameters corresponds to setting the following menu entries.

disp.sync	sync
disp.be_mesh_only	BE mesh only
disp.pair_boundary	PairBoundary
disp.draw_tile	DrawTile
disp.draw_edge	DrawEdge
disp.draw_resistor	DrawResistor
disp.undraw_resistor	UndrawResistor
disp.draw_out_resistor	DrawOutResistor
disp.draw_fe_mesh	DrawFEMesh
disp.draw_equi_lines	DrawEquiLines
disp.draw_be_mesh	DrawBEMesh
disp.draw_green	DrawGreen
disp.3_dimensional	3 dimensional
disp.draw_sub_term	DrawSubTerm
disp.draw_delaunay	DrawDelaunay
disp.draw_sub_resistor	DrawSubResistor

The following two integer parameters may be used to set the width and height of the display window.

disp.width	*width*
disp.height	*height*

With the following parameter the window of the layout that is displayed is specified (default the whole layout is displayed). The parameter requires as arguments the x-left, x-right, y-bottom and y-top coordinates of the window. The coordinates are specified in lambda.

disp.layout_window *xl xr yb yt*

When the following parameter is on, substrate terminals are drawn with their tile (mask) color. When it is off, only the border of the substrate terminals is drawn.

disp.fill_sub_term *boolean* (default: on)

When the following parameter is on, drawing results of extraction prepasses are not cleared. This makes it possible to e.g. keep the boundary-element mesh of substrate resistance extraction in the final picture that is displayed.

disp.save_prepass_image *boolean* (default: off)

4. Mask colors

The colors that are used to display the different masks/conductors, are specified in the space element definition file after the (optional) specification of the new masks.

Syntax:

```
colors:
  mask color
   .
   .
```

A specification consists of a mask name followed by a color. The mask name may be an original mask name, a mask name created using the "new" statement, or the string "@sub". For masks that are created in the element definition file using the "new" statement and for the "@sub" mask, only boundary-elements of conductors of that mask will be drawn in that color (i.e. DrawTile will **not** draw the color of that mask).

Available color names are all X color names (these are normally found in the file '/usr/lib/X11/rgb.txt'), including the special color 'glass' which means in fact 'invisible'. Moreover, RGB values can be specified in the X-fashion with the '#' character replaced by the '@' character, since the former is already used to specify comment in the element definition file. Black is drawn dominant, all other colors are mixed. For example, red and green becomes yellow.

An example to specify the colors of masks np, nd, nm, ni, nb, nx, ng, nc and @sub is as follows:

```
colors :
    np      red
    nd      green
    nm      blue
    ni      @CCC
    nb      magenta
    nx      cyan
    ng      black
    nc      black
    @sub    pink
```

5. Usage of .Xdefaults

The *.Xdefaults* file in the users home directory is used to set X window related preferences (unless a resource database was build using the command 'xrdb'). Since *Xspace* uses the X toolkit and the resource manager a very large number of parameters can be changed by the user. The following is a list of some of the more useful resources with their default values:

```
Xspace*.background:             LightSteelBlue
Xspace*.borderColor:            black
Xspace*.font:                   screen.b.16
Xspace*Command.background:      yellow
Xspace*Command.foreground:      black
Xspace*Label.background:        yellow
Xspace*Label.foreground:        black
Xspace*SaveUnder:               False
Xspace*Scrollbar.background:    yellow
Xspace*Scrollbar.foreground:    black
Xspace*canvas.background:       black
Xspace*canvas.borderColor:      LightSteelBlue
Xspace*canvas.borderWidth:      5
Xspace*canvas.height:           375
Xspace*canvas.width:            500
Xspace*menu.borderColor:        LightSteelBlue
Xspace*menu.hSpace:             2
Xspace*menu.vSpace:             10
Xspace*messageWindow:           False
```